



EACTS
European Association For Cardio-Thoracic Surgery

Minimally Invasive Techniques in Adult Cardiac Surgery

Course Directors: P Suwalski, Warsaw; V Falk, Berlin and P Sardari Nia, Maastricht

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Course Report



20-22 June 2017

Warsaw, Poland

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Introduction

The European Association for Cardio-Thoracic Surgery's course on Minimally Invasive Techniques in Adult Cardiac Surgery (MITACS) ran from 20-22 June, 2017 at the Central Clinical Hospital of the Ministry of Interior and Administration in Warsaw, Poland. With a record attendance of over 200 cardiothoracic surgeons, cardiologists, cardiac anaesthetists, perfusionists, residents and fellows, the course served as a vibrant and engaging forum focusing on key topics in the minimally invasive field.

MITACS is designed to provide the participants with a platform and a basis for starting the same programme at their own institute. To emphasise the success of the teamwork approach, invited experts share their expertise over three days of keynote presentations, live-in-a-box videos and live surgical case transmissions in order to demonstrate the technical aspects of the new procedures.

Ten live cases took centre stage, with enthralling explorations held primarily in 3D, thus providing a more immersive experience for the audience. What's more, the MITACS course



also emphasised hands-on experience, with a dedicated 'SimCity' session that provided an opportunity to practice minimally invasive techniques and skills using a wide range of technologies and equipment under the expert guidance of our faculty and industry partners.

MITACS forms part of EACTS' ongoing Academy programme, providing training courses of the highest quality which are attended by delegates from all over the world. This report contains just a few of the highlights from this year's MITACS course, thus we encourage you to head to www.eacts.org to register your interest for upcoming Academy courses, and get involved in person.



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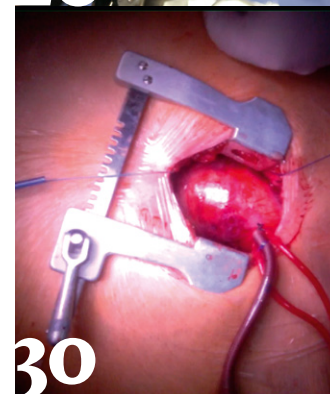
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Interview:

Piotr Suwalski

This year's MITACS course took place at the Central Clinical Hospital of the Ministry of Interior and Administration, Warsaw, Poland, hosted by course Director Piotr Suwalski and colleagues.

We caught up with Professor Suwalski to gather his perspectives on the course, its programme, and its location this year.

What did it mean to you and the team to host this year's MITACS course at your hospital in Warsaw?

We were very happy to host such a course – organised by the biggest and most prestigious cardio-surgical association in the world, EACTS. We were very happy to share our experience in minimally invasive techniques, especially via the numerous live cases. It was also a privilege to host, observe and work together with European surgeons and their teams in the OR, and to host and listen to so many world-class lecturers during those three intensive days.

It was extremely important for us to have, for the first time, the EACTS course in this region of Europe. The record attendance, with over 200 people – and including young people from the region – confirms the high need for the course. We were also very happy to see that the course has attracted so many surgeons, not only from Europe, but distant countries like Taiwan, India and Brazil.



Looking to the programme, what are the course's particular strengths from your perspective?

From the very beginning we were trying to cover the whole spectrum of the current techniques in minimally invasive cardiac surgery, including transcatheter techniques – and I think we succeeded. We managed to coordinate extremely interesting lectures on a particular topic alongside 10 live surgeries, so that an attendee could

► 5

4 ► observe and learn in the best possible way.

During the three-day programme, we went through minimally invasive and totally thoracoscopic cutting edge aortic valve and aneurysm, mitral, arrhythmia and left atrial appendage procedures. We did not avoid difficult and challenging cases.

That being said, an attendee could appreciate a state-of the art current standard minimally invasive surgical procedure and – I would say – all compiled in a package ready to take home and implement. That was our goal.

What would you say to encourage someone thinking of coming next time?

It is simply the best course focusing solely on adult minimally invasive techniques, covering the whole spectrum, and supported with top lectures and live surgeries of different levels of difficulty. You can also discuss and observe transcatheter techniques performed by

surgeons – this is extremely important, especially for young colleagues, since the technology is heading this direction, and we simply must be onboard.

A final message?

I would like to thank EACTS: it was a fantastic and successful experience. I would also like to thank the co-directors of the course, Peyman Sardari Nia and Volkmar Falk and his Berlin Heart Center team, all lecturers and participants, and with special thanks to Joerg Kempfert and Nicolas Doll.

Furthermore, I am very grateful to the Polish Club of Cardiac Surgeons and the Polish Association for Cardio-Thoracic Surgery who have supported Polish and Ukrainian residents attending the Warsaw course. Finally, I really do appreciate the dialogue and the help from sponsors.

Overall, it has been a very successful event and I am already looking forward to the next one!

Piotr Suwalski and the team at the Central Clinical Hospital of the Ministry of Interior and Administration, Warsaw, Poland



Call for registries in standalone LAA occlusion



There is a very urgent need for reliable, real-life data on surgical thoracoscopic left atrial appendage (LAA) occlusion as a standalone procedure, delegates heard from Anna Witkowska (Central Clinical Hospital of the Ministry of Interior and Administration, Warsaw, Poland).

Sharing her opening perspectives, Dr Witkowska began by underlining that, as we know, stroke is the most devastating complication for atrial fibrillation (AF) patients, with a five-fold higher risk than in the general population, with 15% of instances being silent strokes. While oral

anticoagulant (OAC) therapy has emerged as an effective treatment option, she cautioned that as high as 47% of patients could present with contraindication for OAC, with discontinuation rates also being high (e.g. 20-25% after 18-24 months, as shown in some datasets).

Indeed, Dr Witkowska stressed that a prior history of severe bleeding, intolerance or lack of compliance means that 30-50% of eligible people with AF do not receive OAC treatment.

She went on to note that there are additional issues for warfarin, including drug and diet interaction, a need for stringent monitoring, and a

- 6 ► narrow therapeutic window, with time in therapeutic range of only 50% to 60%.

Even with the relatively well-tolerated novel OACs (NOACs), the proportion of patients discontinuing their NOAC therapy during study follow-up has been shown to be as high as 15% to 25%, she said. There is also a residual stroke risk of 2% to 5% annually, despite optimal anticoagulation.

“Nowadays, atrial fibrillation is mainly a disease of older people ... there are also many more patients who also have coronary artery disease and acute coronary syndromes,” continued Dr Witkowska. “The recently published [2016 ESC] guidelines¹ showed that the addition of NOAC therapy increased the risk of bleeding from 79 to 134%, while reducing the recurrent ischaemic events only marginally [in patients without AF].”

She added that the same guidelines stated that LAA occlusion was non-inferior to vitamin K antagonist treatment for the prevention of stroke in AF patients with moderate stroke risk, with a possibility of reduced bleeding rates in the patients who continued follow-up.

What’s more, those guidelines placed LAA occlusion as a preventative stroke treatment in a Class IIb, Level B category: “i.e. it may be considered as a treatment option,” she said.

“Also, the EACTS Guidelines for the surgical treatment of atrial fibrillation² do not find a proven benefit of surgical LAA exclusion, but if it is contemplated, they recommend specially-designed devices for such a technique.”

Dr Witkowska argued that there is still great geographical variation in the current indications for LAA closure, thus leading to a lack of scientific consensus on the absolute or relative contraindications for OAC therapy in patients with AF. In turn, the exact indications for closure have yet to be clarified.

Harking back to ESC 2016 Guidelines, she continued: “LAA occluders have not actually been tested in the subgroup of patients with contraindications to NOAC therapy, nor compared to NOAC therapy in patients at risk of bleeding. There is a need for adequate data to prove its place in clinical treatment.”

As detailed in a 2015 study,³ in-hospital complications and adverse events (including total rate of cardiac complications, and periprocedural neurological events) in real-world patient

“I think there is a very urgent need for reliable, real-life data on surgical thoracoscopic LAA occlusion as a standalone procedure. We need to find out how many patients need this.”

Anna Witkowska

populations undergoing LAA closure in the US were a little higher than previous clinical trials. “However, a multi-centre registry published this year in the UK⁴ showed that, despite the complication rate, LAA occlusion can be performed safely, and can potentially reduce the risk of thromboembolic events,” said Dr Witkowska.

“There was a procedural success of 92%, with only 26 patients disqualified from the therapy due to anatomical considerations.”

She went on to stress that a criticism of the current data on the effectiveness of surgical excision or occlusion on reducing stroke in patients with AF is that it is limited to observational studies and retrospective ► 8

- 7 ► studies. In fact, one 2015 paper reasoned that a ‘it is not prudent to argue for open surgical procedures specifically to target LAA in patients who are not undergoing cardiac surgery for other reasons’.⁵

However, Dr Witkowska did emphasise the data surrounding AtriClip [Atricure Inc, USA], including a study that evidenced its persistent LAA exclusion, tissue in-growth, homogenous epithelialisation, and avoidance of damage to adjacent structure⁶, with another study⁷ detailing successful LAA exclusion in 67 out of 70 patients (95.7%) undergoing median sternotomy.

Speaking more of AtriClip’s value, she noted that its benefit is independent of LAA morphology and size. “Even very big appendages can be safely closed,” she said, adding that it is feasible in reoperation, concomitant to minimally invasive direct coronary artery bypass as a thoracoscopic access, and concomitant to totally thoracoscopic ablation.

Data still lacking

In a quest for more data, Dr Witkowska and colleagues have started a registry of standalone thoracoscopic LAA exclusion in five Polish centres, in a consecutive patient cohort (30 patients since 2015) with the following characteristics: Age 72(+/-9) years; CHA₂DS₂-VASC Score from 2 to 7; HAS-BLED Score from 2 to 7; mean procedure time of 30 minutes (+/-10); minimum, mean time for clip deployment of 10(+/-5) minutes; extubation on-table.

Although the data are still early, Dr Witkowska relayed the promising results thus far, with no strokes, no haemorrhages and no instances of clip malposition. As such, ongoing data collection hopes to uphold these results.

“In conclusion, I think there is a very urgent need for reliable, real-life data on surgical thoracoscopic LAA occlusion as a standalone procedure. We need to find out how many patients need this procedure, what kinds of indications there are, do we have any complications (and what kind), and how can we deal with them?”

Finally, she added, there is a need to elucidate how to treat patients after successful LAA occlusion, including the optimal postprocedural drug strategy.

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Perspectives from MITACS...



Live cases, and also the scientific programme parallel to it, are a good combination that can be taken further each time.

Mahmut Ay

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Perspectives from MITACS...



It was an incredible experience ... the facilities, the organisation, and the place were all excellent. The high professionalism of the operators, and their ability not only to perform nice surgeries – but also to explain clearly each step and action – made the visualisation of live cases perfect.

Sergiy Siromakha

Amosov National Institute of cardio-vascular surgery NAMS of Ukraine, Kyiv, Ukraine

Patient and access selection in minimally invasive AV surgery

Peyman Sardari Nia (Maastricht University Medical Center, the Netherlands) took to the podium to chew over the ins and outs of minimally invasive aortic valve replacement (mini-AVR), beginning with a clear statement: conventional AVR is one of the easiest operations in cardiac surgery, so how can it be beaten?

With a conventional AVR cross-clamp time of less than 60 minutes, an operation time of around 120 minutes, hospitalisation rates between 4-7 days, and low mortality rates (0-3%), he argued that some would ask why go minimally invasive? “Whether we like it or not, minimally invasive surgery is here to stay, because there are different drives for it,” he said.

As he relayed, these drives can be grouped into several categories: A patient-led demand for minimally invasive techniques; technology-driven, e.g. smaller and smaller instruments continue to be developed, and technology now allows superior visualisation when compared to open surgery; physician-driven – such as innovations in the operating room, or in terms of career advancement; and care-driven (“re-thinking” of care), including myths about open procedures, and myths about pre- and post-operative care.

Using TAVI as an analogy, Dr Sardari Nia continued: “TAVI entered the market for very high-risk patients, and now it is taking over the normal sternotomy. But why hasn’t that happened for mini-AVR? The adaptation rate is still very low. That is very important question to ask.

“I think there is also an internal

“Whether we like it or not, minimally invasive surgery is here to stay.”

Peyman Sardari Nia

battle between conventional and new technology. We have always been looking for ‘wonder’ approaches – with safety, efficacy, reproducibility, the least trauma, and applicability by all surgeons for all patients. However, there is a paradigm shift in medicine – and what we do as cardiac surgeons – which is the personalised approach.

“Which patients will benefit, and who are the most suitable for a certain technique? It is a very important question: there is a difference between a benefit, and being suitable.”

He continued: “The other thing is, in the personalised approach, there is a direct association with volume and outcome. Dedicated teams enhance safety, efficacy and reproducibility.”

Discussing the indications for a minimally invasive approach, Dr Sardari Nia stressed that if we consider the indications and contra-indications, we have to consider the many variations of techniques being used, including: mini-sternotomy (manubrium, IC3, IC4, IC5); mini-thoracotomy; venting (pulmonary artery, pulmonary vein, direct versus extracorporeal); cardioplegia (blood cardioplegia versus crystalloid, antegrade versus retrograde); and cannulation site (central versus peripheral).

“These variations are also reflective of the field of cardiac surgery and minimally invasiveness. It is more about craftsmanship than science. That is something that we have to move from,” he said.

“Mini-AVR is a minimal-access





10 ► approach, but the goal is not minimal access. The same indications apply as AVR, but what is important to remember is that no compromises should be allowed for the sake of minimal access, [e.g.] cardioprotection, and duration of the procedure.”

Describing the relative contra-indications from his perspective, Dr Sardari Nia began with the pre-operative considerations: ‘Exotic experiments’, such as Bentall/redo-AVR/AVR+ proximal RCA graft – (adding that while they have been performed successfully, whether they are sensible and beneficial for the patients is another question); and aortic dilatation, noting to be very careful because such patients sometimes need more extensive operation.

He also listed elongation of the ascending aorta (as it makes the operation

much difficult because of the lower aortic root in relation to mini-sternotomy), poor left-ventricular function, and bicuspid valves with regurgitation, as those patients have a very bulky calcification along with the regurgitation, and are as such not very good candidates.

Operatively, he listed more contra-indications: “If you don’t do a CT scan and pre-operatively exclude patients that are not suitable, then you can test whether you can reach the aortic root with your finger. If the root is too far away, you cannot do the operation. Secondly, if at any stage you feel that a compromised is being made with regards to cardioprotection, there is no shame in conversion.”

On the topic of operative planning, Dr Sardari Nia reasoned that an important question concerns whether certain techniques are applicable to all patients, ► 12

- II ► or whether only anatomically suitable patients should be selected. Speaking from real experience, he highlighted the value of pre-operative 3D CT imaging, creating a virtual plan, and thus allowing pre-operative planning and selection of the best suitable technique.

In 2016, Dr Sardari Nia and colleagues published a study in which patients were evaluated for minimally invasive mitral and

cross-clamp time in the mini-sternotomy group. Conversely, in a 2002 study of 80 randomised patients,³ significant improvements in operative time, blood loss, mechanical ventilation, ICU stay, and pain were witnessed for mini-sternotomy.

A year later, a 40-patient study saw only chest tube drainage being lower for mini-sternotomy patients, with no significant differences found in operative time, bypass time, pain or pulmonary function.⁴

In 2007, results were published from a 60-patient study, with the minimally invasive cohort (n=30) showing significantly improved intubation, drainage, transfusion, pain, pulmonary function and cosmetic criteria.⁵ However, there were no differences in cardiopulmonary bypass time or cross-clamp time.

Fast-forwarding to 2017, Dr Sardari Nia emphasised a recent comparative study of two minimally invasive techniques, compared to median sternotomy, comprising patients from 2005 to 2015.⁶ All patients were propensity matched, with sternotomy, mini-sternotomy and mini-thoracotomy matched in 118 pairs.

In brief, mini-sternotomy versus sternotomy showed no difference in perioperative results. However, mini-thoracotomy versus sternotomy showed a different story, with poorer outcomes that included: significantly higher conversion rates (17 [14.4%]), higher necessity of second pump run (6 [5.1%]) and second cross-clamp (12 [10.2%]), longer cross-clamp times (94 minutes; range, 43 to 231 minutes) and median perfusion times (141 minutes; range, 77 to 456 minutes), and more groin complications (17 [14.4%]).

Tips and tricks

Moving away from the data, Dr Sardari Nia shared his tips and tricks for the audience, first emphasising percutaneous cannulation ► 13

“TAVI entered the market for very high-risk patients, and now it is taking over the conventional sternotomy. But why hasn’t that happened for mini-AVR?”

Peyman Sardari Nia

aortic valve surgery, which showed 30% were anatomically ‘less suitable’, according to 3D reconstruction.¹ “This doesn’t mean that you cannot do these kinds of operations in these patients, but it means you are making a very simple operation very difficult and complicated,” he said.

“Additionally, we also saw that in those patients having a CT scan, about 26% had an incidentaloma on the CT scan: a thoracic tumour, an abdominal tumour, or a skeletal tumour that needed additional care.”

Looking to other studies examining the role of minimally invasive approaches, Dr Sardari Nia focussed primarily on randomised controlled trials, but cautioned that they are still very difficult to compare effectively, given the variation in techniques used.

He began with a 1999 study of mini-sternotomy versus median sternotomy,² in which the main finding was a longer aortic

- 12 ► in the groin and venous central cannulation in the aorta.

“Consider this procedure as a minimal access – as a tool in a toolbox – and don’t use it in every patient,” he continued, “and be very careful in the evaluation and planning – you have all the technology available: i.e. a simple CT scan. You don’t need a 3D reconstruction.”

He added: “A dedicated operative team to help you is very important. If you have a dedicated team it makes everything much easier.”

Dr Sardari Nia also underlined the importance of cardioprotection and conditioning, especially for mitral and

are very important. Patients who receive a minimally invasive procedure really do think that they have had a different kind of procedure, and somehow this has an effect on their recovery.”

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“Patients who receive a minimally invasive procedure really do think that they have had a different kind of procedure, and somehow this has an effect on their recovery.”

Peyman Sardari Nia

aortic valves, chiefly because of “all of the disasters and problems” that can happen in the learning curve relates to insufficient cardioprotection.

“But what is cardioprotection and conditioning? It is many things,” he said, noting: cooling of the patient in the beginning; being very strict with cardioplegia; emptying the heart at all times; using TEE during cardioplegia/unclamping; de-airing; PM-wire connection before unclamping; and use of CO₂.

He concluded: “Minimal access should be considered as a tool in the toolbox, and operative planning can be very helpful. There is no proven benefit other than aesthetics, but aesthetics



Optimising your minimally invasive setup for mitral/tricuspid surgery

Joerg Kempfert (Deutsches Herzzentrum Berlin, Germany) provided a systematic walkthrough of his own centre's setup for mitral and/or tricuspid minimally invasive surgery (MIS), with particular emphasis on the re-do setting. While each setup will be different, he stressed, honing what is already in place can make the difference between a short and easy procedure and a very complex and lengthy one.

On an individual level, the MIS learning curve is unavoidable, but as Holzhey et

al. of the Leipzig Heart Centre described in 2013, it could perhaps be optimised. They published an assessment of the MIS learning curve over a 17-year period, evaluating a total of 3,895 operations by 17 surgeons performing their first minimally invasive surgery of the mitral valve. They found that the typical number of operations necessary to surmount the substantial MIS learning curve was between 75 and 125, and that >1 operation per week was necessary to maintain good results.¹

His own transition from direct vision to ► 15

- 14 ► fully endoscopic, explained Dr Kempfert, involved shifting from rib-spreading of the second intercostal space with 0-degree endoscopic visualisation to the use of 30-degree endoscopy in the lateral aspect. And 3D endoscopic vision provides the depth perception and consistent visualisation that made 2D vision so challenging.

Turning to the MIS setup, Dr Kempfert questioned whether double-lumen tubes are necessary. “Yes, they are always good if something goes wrong and if there is residual bleeding,” he noted. “But how

– encompassed by cannula position, type, and pump flow. These three elements are paramount, described Dr Kempfert: “The question is, do I need a jugular (SVC) vein cannula? Yes, you can definitely consider it in tricuspid cases. However, it is going to prolong induction time, and you don’t really need it in mitral as long as the overall drainage is good, and as long as you use any femoral cannula that is high up enough in the SVC. The problem is that most of the cannulas on the market are too short, especially for tall patients and you might have this ‘pop out’ issue.”

He continued: “A very good trick in really obese patients with drainage problems (or if you anticipate problems), is to puncture the left femoral vein and put in a wire (but do so before you give heparin). Then if you have drainage problems later on, you could put in a contralateral second cannula.”

Moving on to describe his setup for complete bypass specifically in tricuspid MIS, Dr Kempfert went over venous cannula options. The first option comprises standard femoral plus percutaneous jugular cannulation – the latter adding considerable procedural time. The second option, involving a dual-stage femoral venous cannula (providing SVC and IVC drainage) circumvents this issue, as long as a second contralateral percutaneous cannula at the level of the abdomen is inserted to supplement drainage.

Regarding occlusion of the SVC and IVC for complete bypass in the MIS tricuspid setting, Dr Kempfert explained that standard tourniquets can be used for both the SVC and IVC as long as the procedure is not a re-do. “[In the re-do setting] there are several options: either you go completely without occlusion; or you can use a Fogarty catheter either endovascularly or through your working port. Typically I try to encircle the IVC even ► 16

“The question is, do I need a jugular (SVC) vein cannula? Yes, you can definitely consider it in tricuspid cases.”

Joerg Kempfert

frequently will you encounter residual bleeding, especially if there is a balloon and there is only one incision in the left atrium? It definitely prolongs induction time, and this was our main reason to abandon it in most cases.” Moreover, Dr Kempfert noted the occurrence of ‘white lung’ syndrome associated with double lumen tubes, adding that the only cases in which they are used in his centre is in re-do and impaired right ventricle cases.

On left atrial retractors, Dr Kempfert highlighted the common issue of the P3 fold, dealt with either by suturing to pericardial tissue or by the use of an advanced retractor such as the MICS USB HV Heart Retractor (CardioMedical/USB Medical), which includes an extra lateral arm and adjustable blade angle.

A further element of the setup for mitral and tricuspid MIS is venous drainage

- 15 ► in re-do, to gain better access to the left atrium. Then I either leave the SVC open or use a balloon or gauze.”

Clamping options were then discussed. On the ‘no clamping’ option, Dr Kempfert commented: “This is very straightforward and convenient. However, there seems to be a potential risk of air embolism (at least theoretically), and you sometimes get suboptimal exposure due to bleeding.”

Clamping options included the

dissect adhesions behind the aorta: “This is why most people don’t do it in the re-do setting; they go for fibrillating heart.”

Negative experiences with the Chitwood clamp led Dr Kempfert to the IntraClude system (Edwards Lifesciences, USA), which comprises a catheter and intra-aortic occluding balloon. While this method is appealing in the re-do setting, avoiding bleeding risk and aortic manipulation, wire skills are required and a dedicated monitoring team is necessary in order to recognise distal migration.

Dr Kempfert also discussed retrograde cardioplegia, noting the Edwards ProPledge device as well as the standard coronary sinus catheter, where aortic regurgitation or patent bypass grafts are present.

“Even if you are experienced, discuss with your team whether there is further room for optimisation to further ease your procedures,” summarised Dr Kempfert. “I am quite convinced that these tiny details will make a difference.”

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“Discuss with your team whether there is further room for optimisation to further ease your procedures.”

Joerg Kempfert

Chitwood or ‘detachable’ Glauber clamp, with the advantages that this is similar to the standard sternotomy setup, with no additional cost, and allowing for percutaneous low-profile femoral arterial cannula. This however comes with a significant risk of bleeding due to possible injury of the left atrial appendage, pulmonary artery, or ascending aorta. With respect to re-do procedures, added Dr Kempfert, it can be cumbersome to



Is surgical AVR still a gold standard?

In recent years, transcatheter approaches to aortic valve treatment have seen a great rise, leading many to question whether surgical aortic valve replacement (AVR) has finally been surpassed. Tackling this topic was Piotr Suwalski (Central Clinical Hospital of the Ministry of Interior and Administration, Warsaw, Poland), who offered his perspectives from real-world practice.

With aortic stenosis being the main valvular problem seen in an increasingly ageing patient population, TAVI has,

unsurprisingly, found great footing as a new treatment paradigm. But as Professor Suwalski highlighted, along with this increased TAVI adoption, an interesting phenomenon has also occurred – at least in some centres – whereby TAVI or TAVR utilisation also leads to more referrals to surgical AVR. “It is not true in all centres and all countries, but at least in some of them,” he said. “Clearly it is good to have the full surgical portfolio for treatment of aortic stenosis.”

In terms of mortality, rates in isolated AVR, for example, have seen a steady

- 17 ► decrease. “Although patients are getting more and more difficult, the risk-adjusted mortality is going down,” commented Professor Suwalski.

He added that while mortality rates in TAVI are improving, it is important to remember that even in very high-volume centres, mortality is still far from perfect. Indeed, plots of 30-day mortality versus STS-PROM scores point to a trend for marginally-better outcomes when using surgical AVR in the lowest-risk patients, while TAVI may be better for high STS-PROM scores.¹

“Regarding the type of prosthesis, the biological valves are the best choice, and this is even true in younger patients,” said Professor Suwalski. He went on to stress that while there is still structural valve degeneration (SVD) with biological valves, generally long-term survival is better. “Why? Because bleeding – and other

surgical valves had numerous problems, newer valves have dramatically improved haemodynamic performance, including reduced rates of prosthesis-patient mismatch (PPM).

PPM is associated with stunted symptom improvement and functional class, as well as impaired exercise capacity, less regression of LV hypertrophy, hindered improvement in coronary flow reserve and more adverse cardiac events. All told, PPM has a significant impact on both short- and long-term mortality.

Continuing with other crucial aspects that must be considered, Professor Suwalski highlighted the minimally invasive approach, and its influence in classical surgical AVR. “It has been proven to offer some advantages, including reduced morbidity and mortality, especially in elderly patients, and in terms of parameters such as respiratory time, blood usage and so on,” he said.

“The next question to be asked is cost-effectiveness,” he said, quoting a Canadian study² which notes that ‘transfemoral TAVI was a cost-effective option compared with standard management for inoperable patients with severe, symptomatic aortic stenosis, but it might not be a cost-effective treatment compared with surgical aortic valve replacement for operable patients.’

“Of course, TAVI can depend very much on reimbursement. We all know that,” he noted.

Finally, he underlined the importance of speaking the same language, reasoning that it is difficult to “compare apples to oranges” when analysing data that cross-examines TAVI versus surgical AVR. Similarly, he postured that we should be careful in how we all report data, including suboptimal analyses, holes in data sets, and other methodological shortcomings. This can, after all, lead to subjective bias

“I still think that surgical AVR is the gold standard, offering excellent results ... Of course, there are a number of challenges, and there is need for improvement.”

Piotr Suwalski

complications – occur less when using biological valves. And you can do a safe elective re-do,” he said.

“What’s more, there is reduced morbidity, and quality of life – another important issue – is much better.”

Professor Suwalski went on to discuss the role of haemodynamics in SVD creation, first underlining the importance of good gradients/flow through the valve. He added that while early-generation

18 ►

for one procedure over another.

Harking back to the original question of whether surgical AVR is still the leading approach, Professor Suwalski shared his concluding remarks: "I still think that surgical AVR is the gold standard, offering excellent results, especially in terms of durability, haemodynamics, low pacemaker and paravalvular regurgitation rates, and for cost-effectiveness. Of course, there are a number of challenges, and there is need for improvement."

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MITACS Course Report

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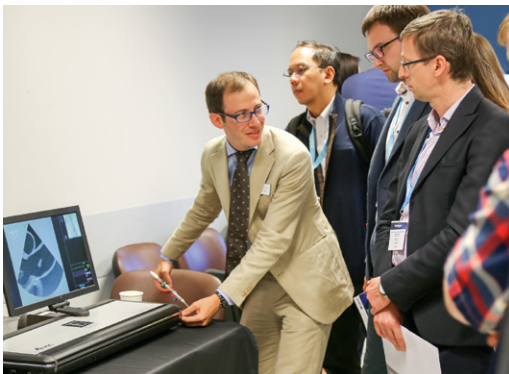
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SimCity

A key feature of the MITACS course was the hands-on 'SimCity' session, offering an opportunity for all those in attendance to practice minimally invasive techniques and skills using a wide range of technologies and equipment, all under the expert guidance of faculty and industry partners.



We would like to express our sincere thanks to all of this year's SimCity contributors:

AtriCure

Abbott

Edwards Lifesciences

Emtrac

Geister

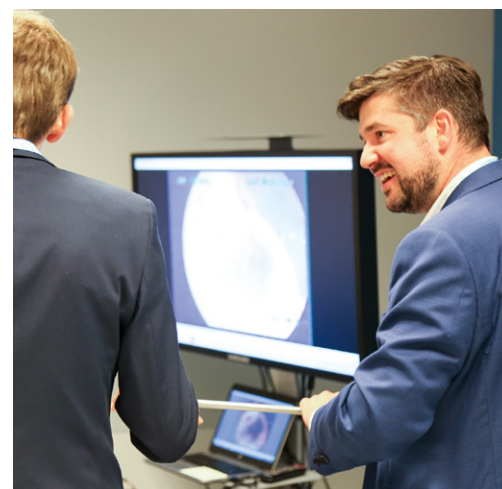
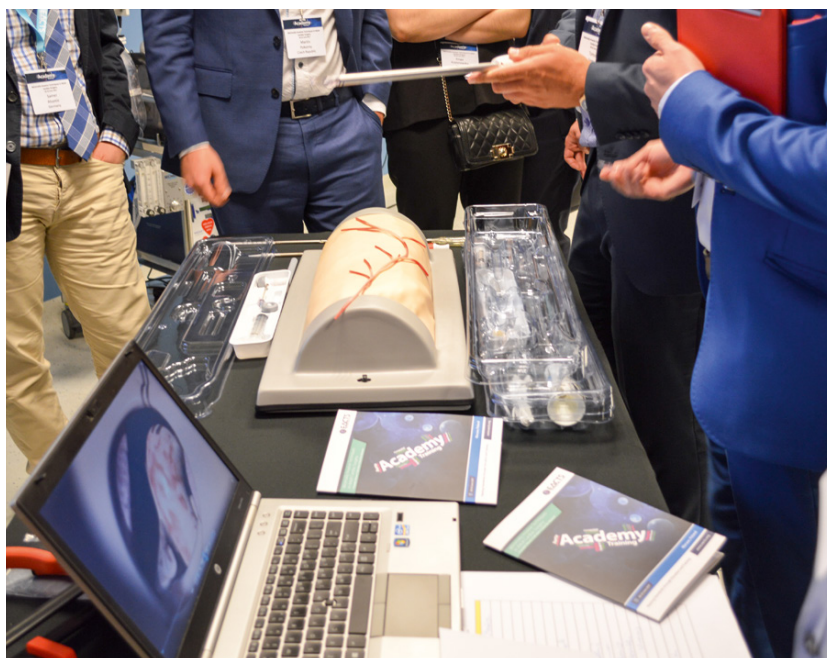
LivaNova

LSI Solutions

MAQUET

Philips

Serag-Wiessner



“What could be better than listening to top lectures, observing live surgery and then having the possibility to train and practice a particular technology, hands-on, guided by specialists? This is a very important part of training in order to implement new programmes, or to widen the spectrum of those already existing.

“It is also important for industry not only to present their solutions but also to establish new personal contacts with the interested surgeons.”

Piotr Suwalski





Schooling the surgeon in TF-TAVI

Axel Unbehaun (Deutsches Herzzentrum Berlin, Germany) provided guidance on the training of surgeons in transfemoral transcatheter aortic valve implantation (TF-TAVI), including an introduction to the sorts of decisions that must be made with regard to vascular access approach, as well as valve, wire and closure choices.

Procedural planning formed the foreground subject, with Dr Unbehaun also

stressing the importance of preparedness for possible complications and challenges that can arise intraprocedurally.

“Before starting to train a person in transfemoral TAVI, that person needs to be convinced to become an active member of the team rather than having a back-up surgical role,” began Dr Unbehaun. He explained that, while surgeons are aware of vascular access strategies for cannulation, percutaneous procedures have distinct features which the surgeon must familiarise themselves with.

He added: “If you want to be a part of a TAVI programme, it is definitely necessary to be familiar with transfemoral strategies as well, because the number of transapical cases is going down.”

This has indeed been the case at Herzzentrum Berlin, he illustrated, where transapical implantation rate, as a percentage of total transapically- and

Femoral access

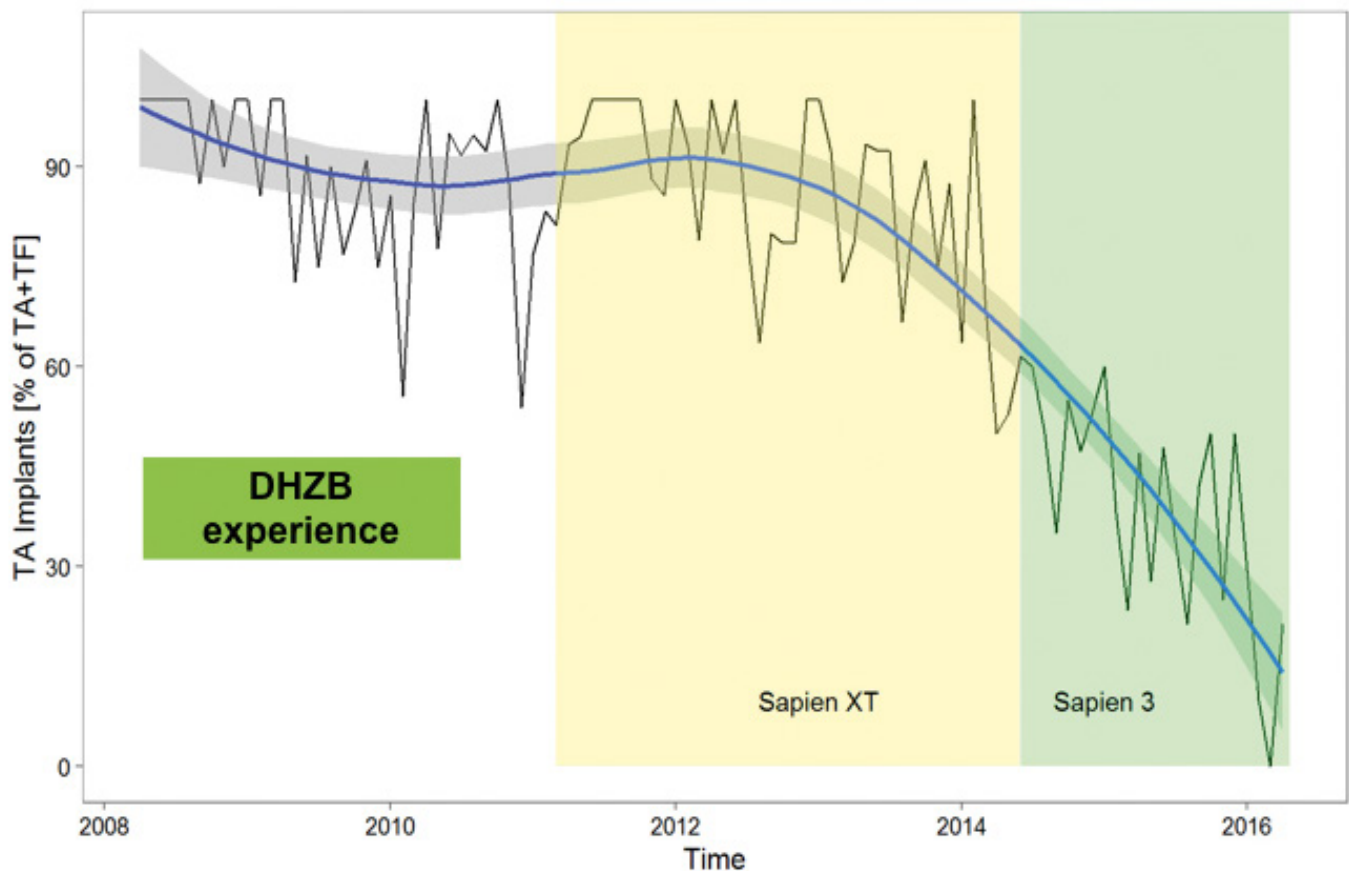


Figure 1. Transapical (TA) implantations, expressed as a percentage of the total transapical and transfemoral (TF) implantations, for patients treated between the years 2008 and 2016. Noted in the chart are timepoints of introduction of the Sapient XT and Sapient 3. (Data pertaining to Deutsches Herzzentrum Berlin, Germany. Figure courtesy of MITACS/Axel Unbehaun).

- 22 ►** transfemorally-performed procedures has drastically dropped from around 90% in 2008 to around 20% in 2016, following the introduction of smaller sheaths that have made the transfemoral approach an option for a greater proportion of patients. (Figure 1)

In 2016, Möllmann et al. carried out a propensity-matched study of 20,340 patients, comparing transapical, transfemoral and surgical aortic valve implantation (AVI). While transfemoral and transapical fared better in terms of

in-hospital mortality than surgical AVI, transapical in-hospital mortality was found to be significantly higher ($p < 0.05$) than transfemoral in this cohort, being around 3-4% greater in each Logistic EuroSCORE category. Notably, intraprocedural vascular complications were found to be a significant issue in transfemoral AVI relative to transapical (5.8 vs. 0.5 %, $p < 0.01$), as was pericardial tamponade (1.2 vs. 0.3 %, $p < 0.01$).¹

“We are aware that there is a major risk of vascular complications,” commented Dr Unbehaun. “Of course patients with these complications do worse when compared with patients without experienced complications. It is an issue, definitely.

“From my point of view, it is absolutely necessary to have surgeons in the team. ► **24**

- 23 ►** If you see a transfemoral case done percutaneously under local anaesthesia it may be fine; but if you have any problems, like annular rupture or aortic dissection, it is good to have the most experienced surgeon.”

From vascular complications Dr Unbehaun turned to evaluate those smaller valve systems that seek to address this issue – first citing the 14 F Evolut-R device (Medtronic, USA): “If you take a look at the [Evolut-R] maximum diameter, and the ratio between the vessel size and the maximum outer diameter, we become aware of the fact that most of these sheath devices are larger than the vessel where we want to go through. This must be taken into account, especially if you want to go through a heavily calcified vessel.

“This is the issue too for the Sapien 3 [Edwards Lifesciences, USA] – a very smart device, a very excellent device for small and complex anatomy, but we must look at the outer diameter of the expanded sheath: it is up to 9.9 mm.

“The Evolut-R is the smallest and most flexible device at the moment. It is 14 F, but the outer diameter is 18 F, and of course this needs to be taken into consideration.”

With respect to procedural planning, Dr Unbehaun highlighted imaging as crucial to the evaluation of the viability of candidate access strategies. He outlined three principle strategies, saying: “The simplest way is by blind puncture, with direct access to the vessel without any further safety net. We call this strategy ‘quick but dirty’.”

He added that, while this may be the quickest way to set up the access site, there are a number of inherent downsides relative to image-guided puncture, such as the risk of occlusion at the femoral bifurcation, the lack of back-up wire, and the amount of contrast dye typically required.

Another often-used strategy is the

cross-over manoeuvre, which allows for image guidance by way of subtraction angiography via an internal mammary artery (IMA) catheter. It also demands less usage of contrast dye: “This is especially important in patients with renal failure,” noted Dr Unbehaun. “But you don’t have a back-up wire in place, and you need extra steps for the repair.”

A third method, ipsilateral back-up puncture, uses a 5 F sheath in the distal femoral artery, with puncture of the proximal common femoral artery in overlay mode to ensure accuracy. While this allows for back-up wire placement, explained Dr Unbehaun, the extra puncture site can increase bleeding risk, and entrapment of the sheath within closure devices is a possibility.

On the topic of closure devices, he continued: “Different devices are available on the market, and their performances differ. Today, we prefer the ProGlide system [Abbott Vascular, USA] rather than the ProStar system [Abbott Vascular] – but this device is helpful in certain specific situations. From my point of view, it has a longer learning curve. And there are more closure devices that we have to expect to become available in the future.”

In highly calcified, tortuous anatomy where a regular wire might stick, Dr Unbehaun noted the properties of a number of different wires that are useful in overcoming such challenges. A 5 or 6 F sheath with a regular Judkins right 4 catheter combined with a hydrophilic soft angled guidewire (such as Terumo’s Glidewire (Terumo, Japan)) lends manoeuvrability, while a stiff wire such as the Amplatz Super Stiff (Boston Scientific, USA) or the Lunderquist Extra Stiff (Cook Medical, USA) addresses calcification.

“We need to be aware of where the calcium is located,” he added. “Is it in the anterior part of the vessel where you

“From my point of view, it is absolutely necessary to have surgeons in the team.”

Axel Unbehaun

- 24 ► want to puncture, or is it on the posterior or (more often) on the medial part of the vessel? If it is on the anterior part, it might complicate the procedure.”

The potential for vascular complications in transfemoral TAVI demand the preparedness of different types of catheters, stents and stentgrafts in the hybrid OR, stressed Dr Unbehaun. Crossing the aortic valve also requires different types of catheter, he continued:

such as pericardial effusion or aortic arch calcification. “You should be aware of the different guidewires and different techniques. But of course it takes a while to be aware of all the tips and tricks.

“In the schooling of a new surgeon, you need to be aware of the length of the learning curve. There is a volume-outcome relationship, so you should be in the hybrid OR as often as possible.

“Implanting the valve is just a minor part of a TAVI programme; the pre-procedural strategy planning is the most important and time-consuming, and of course the surgeon should definitely be involved in this part of the programme. Of course we are adapting to the cardiological way of thinking; but we should be also aware of the fact that there is so much surgical experience around the aortic valve that we could bring to a TAVI programme. Surgeons are part of the TAVI team, and it is worthwhile for them to be trained in transfemoral TAVI as well.”

“Implanting the valve is just a minor part of a TAVI programme; the pre-procedural strategy planning is the most important and time-consuming.”

Axel Unbehaun

“We use the Amplatzer AL-1. For larger anatomies, there are the AL-2 and AL-3 catheters.”

Typical wires for crossing in this region include the straight-tipped wire (e.g. those from Cook Medical) or, in challenging or heavily calcified anatomy, the Terumo straight-tipped Glidewire. Dr Unbehaun also noted the usefulness of dedicated TAVI wires such as the pre-shaped Safari wire (Lake Region Medical, distributed by Boston Scientific).

Preparedness is key, summarised Dr Unbehaun, and this is especially the case with respect to serious complications

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Periareolar totally-thoracoscopic approach to mitral valve surgery: the latest from Warsaw

Radoslaw Smoczynski (Central Clinical Hospital of the Ministry of the Interior and Administration in Warsaw, Poland) presented a joint study from his centre and the Central Clinical Hospital of National Defence (Warsaw) comparing video-assisted minithoracotomy with the totally thoracoscopic periareolar approach for minimally invasive mitral valve surgery.

The advantages of the minimally invasive approach were examined in

mitral valve repair.

In this work, Cheng et al. noted the paucity of long-term data limiting the interpretation of their findings. Moreover, an observed increased risk of neurological events, aortic injury and groin complications demanded further adequately-powered and long-term randomised controlled investigation.¹

More recently, Glauber et al. (2015) followed 1,604 consecutive patients undergoing minimally invasive mitral valve surgery through right minithoracotomy over a 10-year period from 2003 to 2013 in order to address these questions, demonstrating the safety and reproducibility of the minimally invasive mitral valve surgery approach, as well as excellent late results.²

“My question is, can we be less invasive than we already are?” posed Dr Smoczynski during his lecture.

The Warsaw prospective study of minithoracotomy video-assisted access versus totally thoracoscopic mitral valve surgery commenced in 2011, although – as Dr Smoczynski noted – the centre’s experience extends further back. 178 consecutive patients were enrolled (including octogenarians and high-risk individuals), with 130 undergoing video-assisted surgery between January 2011 and September 2015; from then onward, a further 48 patients were assigned to totally thoracoscopic procedures. The primary indication for surgery was isolated

a 2011 meta-analysis and systematic review by Cheng et al.,¹ who found it to be associated with decreased bleeding as compared to conventional open mitral valve surgery, as well as decreased blood product transfusion, incidence of atrial fibrillation, sternal wound infection, scar dissatisfaction, decreased ventilation time, intensive care unit stay, hospital length of stay, and reduced time to return to normal activity, without detected adverse impact on long-term need for valvular reintervention and survival beyond one year. The investigators identified no difference in all-cause mortality between minimally invasive and conventional open

“My question is, can we be less invasive than we already are?”

Radoslaw Smoczynski



26 ► to mitral valve regurgitation, mitral valve stenosis, and concomitant functional tricuspid regurgitation.

The two groups did not differ in terms of demographic data with the exception of sex: for anatomic reasons, 83% of the periareolar approach group were male.

“Our surgical technique is based on thoracotomy or periareolar access,” described Dr Smoczyński. “We also used

3D thoracoscopy. Our surgical technique is based on Gore-Tex preformed loop implantation for mitral valve prolapse. In our setup we perform a groin cannulation, mostly by direct incision.”

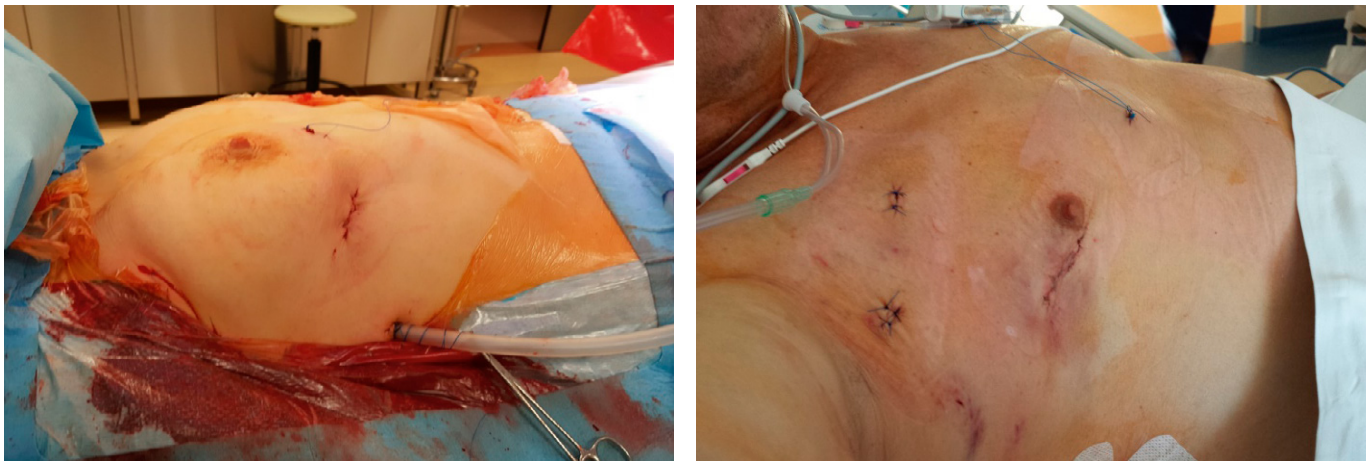
Moving on to results, Dr Smoczyński explained that both groups were comparable with no significant differences in extracorporeal circulation time, cross-clamp time, number of days spent in ICU, extended mechanical ventilation time, stroke and transient ischaemic attack, amongst other factors. He went on to highlight the high proportion of repairs (excluding restenosis) undertaken in both groups, with 97.7% of video-assisted cases requiring repair, and 100% of cases in the periareolar group. No conversions were carried out, either from

“The results after a few weeks are also excellent. The scar is in fact invisible, especially in male patients.”

Radosław Smoczyński



Figure 1. Scarring following periareolar access (above) and minithoracotomy (below)



- 27 ►** minithoracotomy to sternotomy, or from totally thoracoscopic to minithoracotomy. In-hospital mortality was 3.1% in the video-assisted group, and 2.1% in the periareolar group, although this difference did not reach statistical significance.

The results of periareolar and minithoracotomy incisions in male and female patients are shown in Figure 1. “The results after a few weeks are also excellent,” Dr Smoczynski explained. “The scar is in fact invisible, especially in male patients. In female patients we try to perform incision under the breast, to produce a cosmetic result.

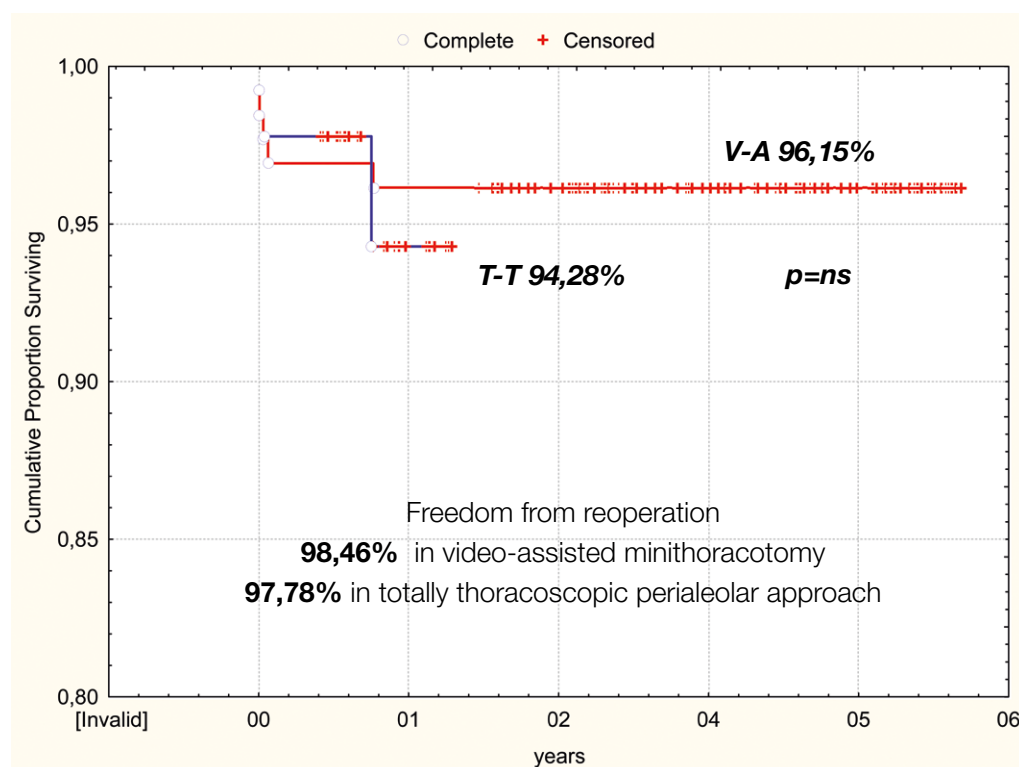
“We have six-year follow-up observation of the video-assisted group – we observed 96% overall survival. We also have observation of the totally-thoracoscopic group of 1.5 years, where

overall survival is 94%. Freedom from reoperation in the video-assisted group is 98%, and in the totally-thoracoscopic periareolar group it is 97%. The groups did not differ significantly [Figure 2].”

In his concluding remarks, Dr Smoczynski summarised: “Total thoracoscopic periareolar mitral valve surgery is feasible in consecutive male and in selected female patients. Totally thoracoscopic access is comparable to the mini-thoracotomy approach for mitral and tricuspid repair or replacement according to perioperative outcomes. Long-term results did not differ between the totally thoracoscopic periareolar access and the video-assisted technique. We also find 3D thoracoscopy a really helpful device, especially in complex valve repair.”

Figure 2.

Overall survival pertaining to the totally thoracoscopic periaortic approach ('T-T') from outset to 1.5 years was 94.28%; in the video-assisted minithoracotomy ('V-T') group from outset to six years, overall survival was 96.15%. Freedom from reoperation was 98.46% in the V-T group, and 97.78% in the T-T group. (Figure courtesy of MITACS/ Radoslaw Smocynski).



28 ► References

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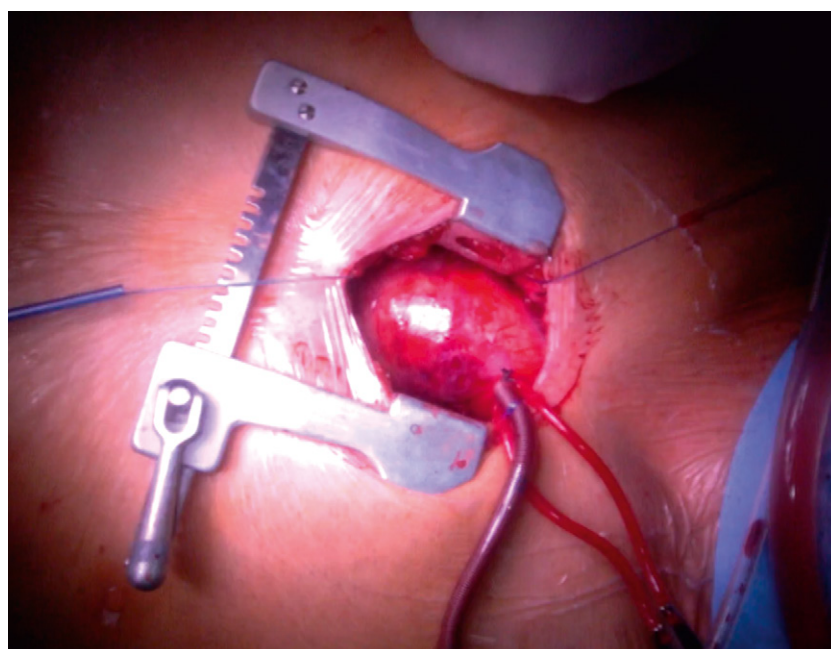
Live ‘mini’ Bentall De Bono case laid bare

A live case demonstrating a minimally invasive Bentall De Bono procedure took place on the first day of the course, led by Piotr Suwalski and colleagues from the Central Clinical Hospital of the Ministry of Interior and Administration.

Named after Hugh Bentall and Antony De Bono, the Bentall De Bono procedure is used to treat combined aortic valve and ascending aorta disease.

The patient was a 49-year-old male, presenting with an aortic root aneurysm and a bicuspid aortic valve, with significant regurgitation and severe calcification of the leaflets, thus precluding aortic repair. In addition, he had asymmetric dilatation of the anterior sinus (50 mm approximately) and dilatation of the ascending aorta (47 mm approximately). The arch diameter was 29 mm.

Figure 1. View of the aneurysm through the small v-shaped access



Other patient notes included a TIA in 2010, along with a left ventricular ejection fraction of 72%, Log. EuroSCORE of 4.6%, and EuroSCORE II of 1.07%. The pressure gradient had a max/mean of 36.5/16.5 mmHg. There was no mitral insufficiency.

As both the operators and panel agreed, these characteristics were a clear indication for a Bentall De Bono procedure.

Proceeding with the operative steps, Professor Suwalski first commented on the aneurysm, visible to the audience through the minimally invasive v-shaped access (Figure 1). Specifically, he noted its apparent neck, thereby enabling it to be clamped reasonably easily.

Before continuing, Professor Suwalski reasoned for direct insertion of Bretschneider cardioplegia into the coronary ostia due to the significant regurgitation present. “We give 1800 ml. Honestly I do not stick to the ml/kg rule,” he said, leading the panel to add that, from their perspective, total volume will depend on hypertrophy and how fast you achieve a good cardiac arrest, as well as whether there is residual motion of the heart.

At this juncture, symposium Chairman Thomas Walther (Bad Nauheim, Germany) questioned the audience as to whether they had performed an aortic root plus ascending aorta procedure with such a small incision. With only a small number of hands raised, Professor Walther underlined that the case was therefore an important demonstration. Professor Suwalski added: “In all types of minimally invasive cardiac surgery, exposure is the key. When we

- 30 ► have a proper exposure, we can do a standard procedure inside.”

After successful cardioplegia, Professor Suwalski relayed his plans to use a mechanical valve for root replacement, given its proven long-term durability – crucial for such a young patient.

Moving on to the topic of suturing for haemostasis, he continued: “You have to always be cautious, but [especially] in this type of surgery because afterwards you have less chance to suture.”

Professor Walther responded: “But don’t make the audience too cautious! Excise the ascending aortic aneurysm, then you will have very good access. Then it’s like a routine aortic root surgery, [so] any stitch has to be perfect anyhow.”

After a short gap, we rejoined the operative team as they were assessing the appropriate sizing of the prosthesis. While imaging at the beginning of the case showed an approximate annulus of 28 mm, as the panel stressed, imaging can over-estimate true sizing, thus it lies in the surgeon’s hands to size accurately. “My tactile feedback tells me that 25 mm will be perfect,” commented Professor Suwalski.

Professor Walther pondered the next steps: “You will probably now go for Teflon-reinforced U-stitches at the annular level, implant, and then get to the coronary second step?”

Professor Suwalski responded, first noting that there are of course different ways to secure the haemostasis in the annular layer. “Yes, we do inverting [U stitches],” he said, adding: “I just go simply through the previous pledget ... in the end I am achieving a more or less continuous Teflon layer.”

Professor Walther commented: “That looks very nice: an interesting technique, and one that should seal off very well.”

As the team finished tying down the annular plane, Volkmar Falk (Berlin,

“The idea of ‘minimally invasive’ is to achieve the same quality. We don’t have to be better... just at least as good as sternotomy.”

Piotr Suwalski

Germany) took to the microphone to pose a question from the audience: “When do you decide to do an open distal anastomosis? These aortic aneurysms sometimes don’t have a neck really, and every time you clamp the aorta, you lose one or two centimetres. Once you do an ascending aortic replacement, you often find that there is some tissue left, and the aneurysm is not completely excluded.

“So what is your decision making there? When do you decide for an open anastomosis and selective antegrade perfusion? And would you do it also with this access?”

Professor Suwalski responded: “I think generally... the idea of ‘minimally invasive’ is to achieve the same quality. We don’t have to be better... just at least as good as sternotomy. I have the same decision making when doing it open or not.”

He added: “If there is no neck, we go for open, and of course you can do more advanced surgery even on the arch and so on ... with this approach I would also do the open anastomosis.”

After securing the prosthesis, Professor Suwalski shared his ‘trick’ for cutting the graft to size (Figure 2), stating: ► 32

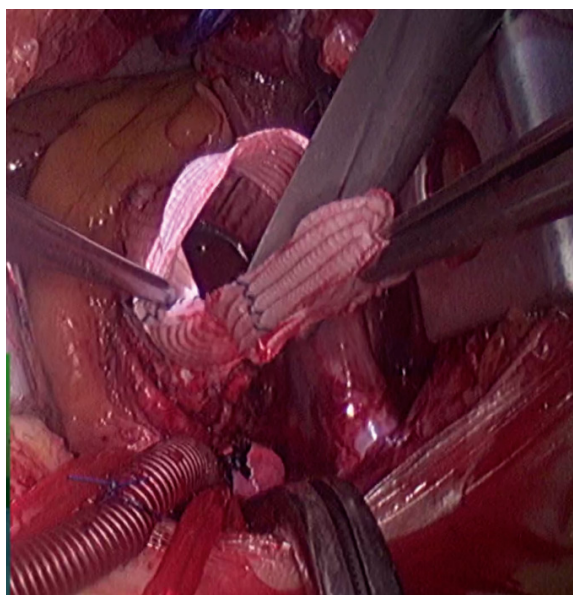


Figure 2. Cutting of the graft, noting that being on the cusp of 'too short' might be optimal

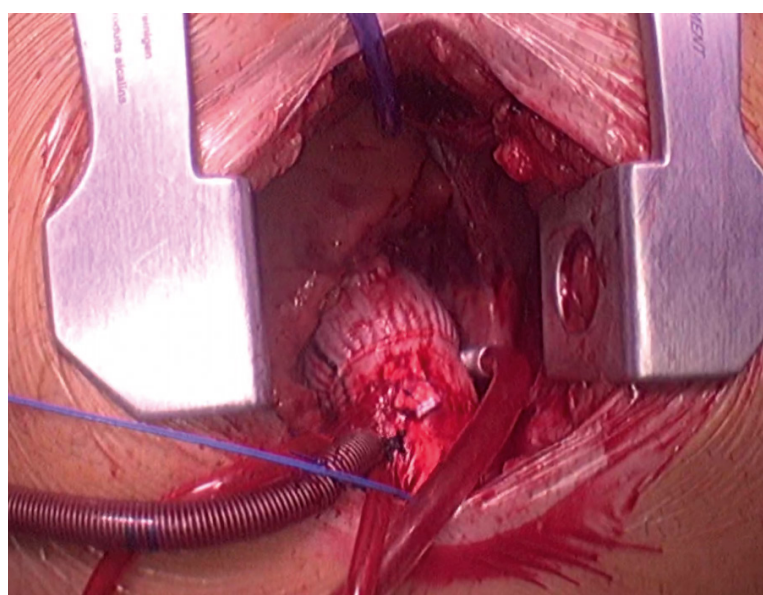


Figure 3. Final result from the case

Perspectives from MITACS...



On the first day, the minimally invasive aortic valve sessions were, for me, especially interesting because I am at the end of my training and I will implement it in my clinical work.

There were also [approaches] not often used in my clinic, so it was an opportunity to learn about these from others.

Johannes Steindl

Universitätsklinik für Herzchirurgie,
Salzburg, Austria

31 ► “I just measure until it looks ‘too’ short on the major curvature, and then I cut ... If it looks too short, it is OK!”

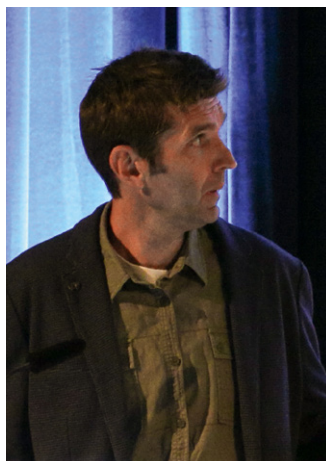
Final result

As the case drew to the end, the operative team shared their final result (Figure 3), to which Professor Walther commented: “It looks perfect! No bleeding, and the length seems to be just right.”

Running through the final echo results (before the patient was weaned off cardiopulmonary bypass), Professor Suwalski and his team relayed clear flow through the left main, circumflex artery, and LAD, along with a good result on the right. There was symmetric leaflet movement, with no perfusion problems, and de-airing was also successful.

Closing the case, Professor Walther concluded: “You managed all of this with a small access: congratulations to the whole team. A big applause from the audience here!”

Mini extracorporeal circuits: the why and the how



Marco Stehouwer

Marco Stehouwer (St Antonius Ziekenhuis, the Netherlands), provided an update on mini-extracorporeal circuits (MECC) in clinical practice, with a focus on practical implications for perfusionist and surgeon alike. Dr Stehouwer is part of the Dutch Heartbeat perfusion group, which comprises 30 perfusionists, encompassing five hospitals and 5,000 procedures annually. At St Antonius Ziekenhuis, approximately 2,000 cardiac procedures are carried out annually, almost all of which are performed on-pump.

Working through the history of heart-lung machines, Dr Stehouwer described how the MECC system represents a culmination of their evolution: “In 1963, we started with the first heart-lung machine. Due in part to the development

and 80s we used bubble oxygenators, and then in the 1990s we started using hollow fibre oxygenators, which we still use today. Some other important disposables that make MECC possible are centrifugal pumps, and specific filters for both venous and arterial lines. And we are able to integrate these systems.”

Describing the MECC setup at St Antonius, Dr Stehouwer noted the circuit of such closed-loop systems, which includes a venous line from the right atrium feeding into a venous bubble trap, then into a centrifugal pump, oxygenator, and back to the patient (Figure 1). “Important to understand is that, in the closed-loop system, the arterial pump is directly attached to the venous line.

“This system is a little bit more dangerous because if air is introduced to the system it will go quite quickly into the centrifugal pump and into the oxygenator. So what we did is block all our entry ports where air can get into the system. We have an air bubble detector in our venous line, and we added a level detector in the aortic vent line.”

Newer generation of MECC systems, such as the Quadrox-iR (Maquet (Getinge Group), Germany), integrate the blood pump, oxygenator and arterial filter. This system, continued Dr Stehouwer, can be attached to the Cardiohelp System (Maquet), which was especially developed for extracorporeal membrane oxygenators. “[It’s] the smallest heart-lung machine,” he noted, adding that additional hardware includes a cell-saver device (in place of convectional circuits’ cardiotomy suction),

“The MECC is not only a small heart-lung machine and a small system – it does more.”

Marco Stehouwer

of computers, we were able to make it a more sophisticated system. For instance, in creating a minimised system it is important to have a level sensor, a bubble sensor. It is also important that these sensors can control your pumps.

“Besides the hardware, the disposables have developed. In the 1970s

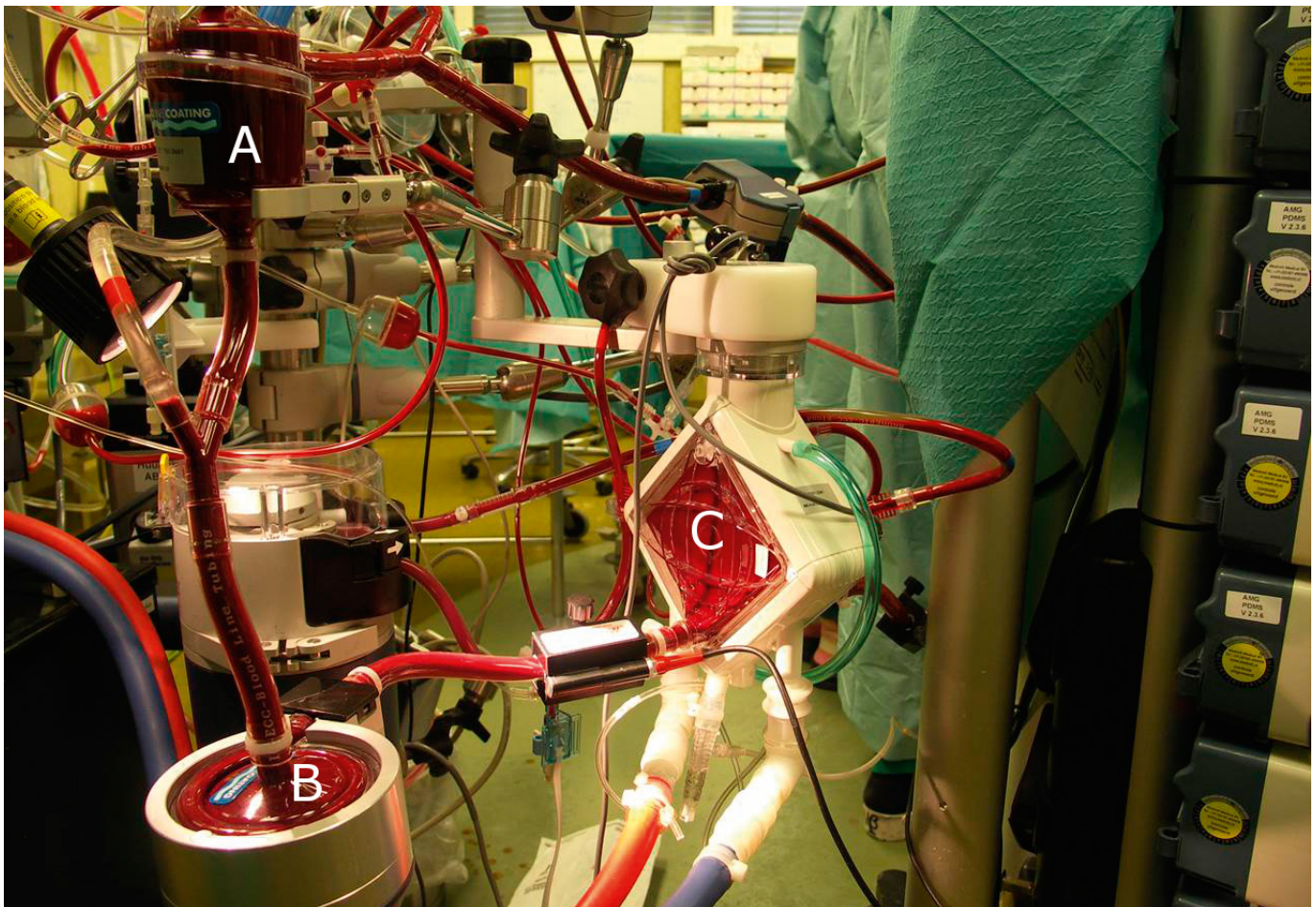


Figure 1. The components of the mini extracorporeal circulation (MECC) system form a closed heparin-coated circuit, comprising a venous line from the right atrium feeding into a venous bubble trap (A), to a centrifugal pump (B), to an oxygenator (C), and then back into the patient via an arterial line. In a closed-loop system, the arterial pump is directly attached to the venous line, whereas conventional systems possess a venous reservoir which provides gravity drainage. Importantly, introduction of air into the closed loop system can pose a significant risk to the patient; hence, use of a bubble detector in the venous line as well as a level detector in the aortic vent line is recommended. The aortic vent is passive, attached to the venous bubble trap.

33 ► whereby intraoperative shed blood can be collected and processed.

The clinical risk factors associated with extra-corporeal circulation, explained Dr Stehouwer, are well known: pathogenicity and systemic inflammatory response can arise from a large foreign surface, cardiomy suction, haemodilution, high volume cardioplegia, roller-pump, and

blood-gas interface. “The MECC is not only a small heart-lung machine and a small system – it does more,” he stressed, pointing out that it in fact reduces, with respect to conventional extra-corporeal circuits, many of the factors that cause activation of endothelial cells, lymphocytes and leukocytes. For example, shed blood goes to the cell saver, so activated blood will be washed; additional advantages include a reduction in prime volume, the use of blood cardioplegia and centrifugal pump, and the absence of hard shell reservoirs and reduced surface area in general.

Following its introduction to St Antonius in 2002, van Boven et al. compared MECC to conventional and off-pump coronary artery bypass graft (CABG) in a retrospective study concerning global oxidative stress and alveolar function. This ► **35**

34 ► provided evidence that MECC significantly reduced transfusion requirements, with oxidative stress markers tending towards improved global organ protection relative to conventional CABG, and reduced markers of alveolar damage with MECC in CABG.¹

Further support for MECC came in 2013, with a meta-analysis by Anastasiadis et al. of RCTs of MECC in heart surgery identifying a reduction in short-term mortality and morbidity – including rates of post-operative myocardial infarction, red blood cell transfusion, and atrial fibrillation – compared to conventional extracorporeal circulation.² On the question of inflammation, Fromes et al. (2002) evidenced MECC's capability in reducing levels of inflammatory markers following CABG in a prospective study comparing it with conventional cardiopulmonary bypass.³

Turning towards the practical implications of MECC usage, Dr Stehouwer continued: "Air management and volume control is very important. All the lines entering your system are guarded by sensors – the bubble detector at the venous site, and the level alarm on the aortic vent. What is really important for the surgeon to understand is that if you have a little bit of air going into the system, and the sensor is activated, your arterial pump will stop."

On volume control, he added: "We use the patient as a reservoir. [You can] put up the legs or put them down when you need some volume or the heart is a bit full. This is the same with drugs, so you need to communicate with anaesthesia."

What are the practical implications of MECC for the surgeon? Dr Stehouwer addressed both air management and volume control: "We ask surgeons to use venous cannulation with double purse strings, to avoid air introduction. One of the disadvantages of a minimised system

is that your centrifugal pump is directly connected to your venous cannula, so sometimes you can have fairly excessive negative pressures. The surgeon also plays a role in volume control, because if you have blood loss it will influence blood flow. I need volume to use the closed-loop system. Surgeons must of course not

"To use these minimised systems, you have to be more attentive – and trained. You have to communicate very clearly with your team."

Marco Stehouwer

forget not to send too much blood to the cell saver. As a surgeon you must control your haemostasis – you have to be very gentle with your patient."

Dr Stehouwer also emphasised team cooperation, communication, and understanding of MECC in his concluding remarks: "To use these minimised systems, you have to be more attentive – and trained. You have to communicate very clearly with your team what you are doing. You have to know a little more about your patient. You have to know what to do when the pump stops as perfusionists, and you need to know what to do when you have massive bleeding, or massive air introduction. The surgeon has to be aware of these problems and has to act on it together with the team."

► **36**

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Perspectives from MITACS...



The course is outstanding. Nicely organised, and [held in] a very appropriate place for it, with good facilities.
 Everything was done perfectly. I'm ready to come next time!

Saulius Raugele

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